GP-448-3 (NP-1479)
(4)

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-090173
(43)Date of publication of application : 04.04.1997

(51)Int.Cl. G02B 6/42

(21)Application number : 07-249643
(22)Date of filing : 27.09.1995

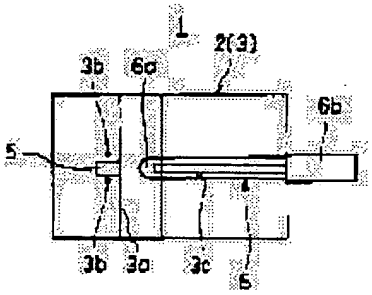
(71)Applicant : FURUKAWA ELECTRIC CO LTD:THE
(72)Inventor : OISHI ISAMU

(54) SURFACE MOUNTING MODULE AND ITS MANUFACTURE

(57)Abstract:

PROBLEM TO BE SOLVED: To highly precisely and inexpensively manufacture a surface mounting module, to enlarge the optical output of a loaded optical semiconductor element by providing projecting and recessing parts, which correspond to the loading position mark of an optical semiconductor element and the positioning part of an optical fiber.

SOLUTION: LD 5 and the optical fiber 6 are loaded on a substrate 2 by aligning an optical axis. The substrate 2 is constituted by base parts 3 and a molding. One of sides sandwiching a crossing groove 3a formed in the direction of width is slightly lower and a mark 3b showing the loading position of LD 5 is formed on one side and a V-groove 3c on the other side in the base parts 3. The molding is integrated with the base parts 3. Since the base parts having the loading position mark of the semiconductor laser and the positioning part of the optical fiber are manufactured from master parts by a minute transfer method, the module can highly precisely and inexpensively be manufactured. Since the base parts 3 are metallic and the molding is constituted by a heat conductive material, the heat radiation of the substrate 2 is superior and the optical output of loaded LD 5 can be enlarged.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

JAPANESE [JP,09-090173,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The surface mount module with which said substrate is characterized by consisting of Plastic solids united with the base components which have the helicopter-loading-site mark of said OPTO semiconductor device, and the positioning section of said optical fiber, and are formed by the precision replica method, and said base component in the surface mount module manufactured by carrying an OPTO semiconductor device and an optical fiber on a substrate.
[Claim 2] The surface mount module of claim 1 which consists of thermally conductive materials, such as a filler metal close resin metallurgy group injection-molding object, as a Plastic solid united with the base components formed by the precision replica method of said substrate.
[Claim 3] Said optical fiber is claim 1 or the surface mount module of 2 with which it has an isotropic refractive index without a core, and the RENZUDO fiber with which the end was processed on the convex surface is prepared in the edge.
[Claim 4] The manufacture approach of the surface mount module characterized by positioning an optical fiber by said positioning section, respectively, and carrying an OPTO semiconductor device based on said helicopter-loading-site mark after irregularity forms an imprint object with a precision replica method from the master components formed conversely and backs said imprint object with a thermally conductive material to the substrate which has the helicopter-loading-site mark of an OPTO semiconductor device, and the positioning section of an optical fiber.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a surface mount module and its manufacture approach.
[0002]
[Description of the Prior Art] In the optic fiber communication system, the system which can transmit a lightwave signal is examined also from the subscriber (home) side as two-way communication. In order to attain such an optic fiber communication system, the surface mount module which combined the carrier and the light emitting device, and the optical fiber was required, and as it was the following, the carrier and the light emitting device, and the optical fiber were combined conventionally.
[0003] That is, when a laser diode (henceforth "LD") and an optical fiber were combined, the relative-position relation between the mark for carrying LD with a sufficient precision on a silicon substrate and this mark was set as submicron order, formed the V groove which positions an optical fiber, and had combined LD and an optical fiber on this substrate. Here, using a silicon substrate is based on the following reasons. A gap of the physical relationship a temperature expansion coefficient is the same as that of an optical fiber, and according to a temperature change does not produce [1st] a silicon substrate easily. The 2nd silicon substrate is being able to form the V groove which positions the mark and optical fiber for LD loading with high precision using lithography, anisotropic etching, etc. A silicon substrate is [3rd] because near-infrared light is made to penetrate and the helicopter loading site of LD or an optical fiber can be observed from a background.
[0004] Moreover, how to combine with LD using the RENZUDO fiber into which thermofusion of the edge was carried out and the convex surface was processed is also learned conventionally. However, when the above-mentioned RENZUDO fiber was used, spacing of LD and a RENZUDO fiber needed to be set to 5-10 micrometers, and the allowable error of LD in the longitudinal direction which intersects perpendicularly with the optical axis of a RENZUDO fiber needed to be set to 1 micrometer or less.
[0005]
[Problem(s) to be Solved by the Invention] By the way, the handling [equipment / expensive processing equipment is required and / a substrate] in a processing process carefully to process a silicon substrate with high precision with lithography. On the other hand, to process it using anisotropic etching, precision needs to improve alignment or it is necessary to control etching conditions for bearing of a silicon substrate to a precision to the mask for etching.

[0006] for this reason, the above — also in which processing approach, if processing conditions are bad, as a result of dispersion and the yield worsening [the process tolerance of said mark in the processed silicon substrate, or a V groove], there is a problem that a product (surface mount module) becomes expensive. In this case, although processing a silicon substrate mechanically is also considered, productivity is bad and there is a problem of becoming expensive in using it for a surface mount module for home use, as a result of processing cost's increasing.

[0007] On the other hand, LD generates heat inevitably in order to pass a big current by the unit area ratio. In this case, since thermal conductivity is not good compared with a metal, heat dissipation nature of a silicon substrate is bad. For this reason, in the surface mount module using a silicon substrate, since the optical output of LD is saturated with a low current value, there is also a problem that an optical output cannot be enlarged. Furthermore, by the surface mount module using the conventional RENZUDO fiber, when the material with a large coefficient of thermal expansion was used as a substrate, there was a possibility that LD and a RENZUDO fiber might be collided and damaged by the temperature change. And since the above-mentioned allowable error is 1 micrometer or less, become dispersion in joint effectiveness, and the yield of the surface mount module assembled falls, or a gap of said longitudinal direction produced when combining LD and a RENZUDO fiber becomes the cause which a manufacturing cost increases.
[0008] This invention was made in view of the above-mentioned point, and can be cheaply manufactured in a high precision, and it aims at offering the surface mount module which can moreover enlarge the optical output of the carried OPTO semiconductor device, and its manufacture approach.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose according to this invention, in the surface mount module manufactured by carrying an OPTO semiconductor device and an optical fiber on a substrate, it has the irregularity corresponding to the helicopter-loading-site mark of said OPTO semiconductor device, and

the positioning section of said optical fiber for said substrate, and constituted from a Plastic solid united with the base components formed by the precision replica method, and said base component.
[0010] Preferably, thermally conductive materials, such as a filler metal close resin metallurgy group injection-molding object, are used as said Plastic solid. Moreover, preferably, said optical fiber has an isotropic refractive index without a core, and that by which the RENZUDO fiber with which the end was processed on the convex surface was prepared in the edge is used for it. Furthermore, in order to attain the above-mentioned purpose, after irregularity formed the imprint object with the precision replica method from the master components formed conversely and backed said imprint object with a thermally conductive material to the substrate which has the helicopter-loading-site mark of an OPTO semiconductor device, and the positioning section of an optical fiber according to the manufacture approach of the surface mount module of this invention, it considered as the configuration which positions an optical fiber by said positioning section, respectively, and carries an OPTO semiconductor device based on said helicopter-loading-site mark.
[0011] Here, the "precision replica method" used on these specifications means a means to imprint the irregularity of master components with the molecular level of submicron order, and to form an imprint object, for example, there are electroforming, the sputtering method, etc. If the base components formed by the precision replica method are used, the helicopter-loading-site mark of an OPTO semiconductor device and the positioning section of said optical fiber will be imprinted by the precision from master components, and the surface mount module carrying an OPTO semiconductor device and an optical fiber will be cheaply manufactured in a high precision. Furthermore, it consists of a thermally conductive material, and if the Plastic solid united with base components is used, compared with the conventional surface mount module using a bad silicon substrate, heat dissipation nature can improve and heat dissipation nature can enlarge the optical output of the carried OPTO semiconductor device, for example, semiconductor laser.
[0012] When that by which the RENZUDO fiber with which it has the isotropic refractive index in which an optical fiber does not have a core at this time, and the end was processed on the convex surface was prepared in the edge is used, it is the distance between an optical fiber and an OPTO semiconductor device 100 The big effect in joint effectiveness as 1 micrometers or more does not produce the allowable error about a gap of the optical axis of the optical fiber in more than mum and the longitudinal direction which intersects perpendicularly with the optical axis of an OPTO semiconductor device.
[0013]
[Embodiment of the Invention] Hereafter, one example of this invention is explained to a detail based on drawing 1 thru/or drawing 7 . LD5 and an optical fiber 6 align an optical axis to a substrate 2, and the surface mount module 1 is carried in it, as shown in drawing 1 and drawing 2 . The substrate 2 consists of base components 3 and Plastic solid 4. V groove 3c is formed in another side for mark 3b which is slightly low and shows the helicopter loading site of LD5 to one side while the base components 3 sandwich crossing slot 3a formed crosswise, respectively. Mold shaping is carried out with a thermally conductive material, for example, the synthetic resin containing filler metal, the ceramic system adhesives containing filler metal, or a metal injection Plastic solid (what is called a common name MIM), and Plastic solid 4 is united with the base components 3 as shown in drawing 3 (a) and drawing 3 (b).
[0014] In order to improve a laser oscillation property, two trenches 5a is formed in a component side, mark 5b (refer to drawing 4 , respectively) positions LD5 on the outside of each trench 5a with high precision to a barrier layer, and it is prepared in it. LD5 is carried in V groove 3c which sandwiched crossing slot 3a, and the location which counters, as shown in drawing 1 . In addition, in drawing 4 , in order to show details clearly, compared with the substrate 2 shown in right-hand side, left-hand side LD5 is expanded relatively, and is drawn.
[0015] An optical fiber 6 is positioned by V groove 3c, and is carried in the base components 3. RENZUDO fiber 6a of a large diameter is attached in an end, and ferrule 6b is attached in the other end. RENZUDO fiber 6a has an isotropic refractive index without a core, and the tip is processed on the convex surface. Ferrule 6b is a single alignment ferrule which connects an optical fiber 6 with other optical fibers.
[0016] The surface mount module 1 constituted as mentioned above is the following, and is made and manufactured. First, the master components 10 shown in drawing 6 were prepared that the base components 3 should be created. Irregularity is created with a precision sufficient in a reverse relation to the base components 3 which have crossing slot 3a, mark 3b, and V groove 3c, and the master components 10 have ridge 10c corresponding to crevice 10b corresponding to protruding line 10a corresponding to crossing slot 3a, and mark 3b, and V groove 3c. Electric conduction ingredients, such as non-electric conduction ingredients, such as silicon, and nickel, Cu, can be used for the master components 10.
[0017] Next, when the master components 10 consist of a non-electric conduction ingredient, flash plating of nickel, the copper, etc. is carried out to a front face, and they are conductor-ized on it. the case where the master components 10 consist of an electric conduction ingredient — a surface conductor ——izing processing is unnecessary. Subsequently, as the master components 10 were used as cathode and shown in drawing 7 (a), the thick electroplating layers 11, such as nickel and copper, were formed in the front face of the master components 10 with electroforming. If many master components 10 are put in order at this time, many base components 3 can be created at once.
[0018] In this case, it is also considered that electrocasting takes several days. However, electroforming has the advantage that the cost which electrocasting takes is also cheap in a electrocasting facility list, in the shape of toothing of the master components 10 being reproducible with a sufficient precision to submicron order. Next, the electroplating layer 11 was removed from the master components 10, and as shown in drawing 7 (b), the base

components 3 which have crossing slot 3a, mark 3b, and V groove 3c were obtained.
[0019] Subsequently, the obtained base components 3 were set to metal mold, Plastic solid 4 was fabricated by insertion mold using the thermally conductive material which consists of synthetic resin, ceramic system adhesives, etc. containing filler metal, and the substrate 2 was created. As shown in drawing 4 after an appropriate time, LD5 has been arranged among the marks 3b and 3b formed in the substrate 2, though it was inside-out. And near-infrared light was irradiated from the upper part of a substrate 2, and LD5 was positioned to the base components 3 in the precision of about 1 micrometer by approaches, such as image recognition, observing each mark 5b and corresponding mark 3b with a vidicon camera with a microscope by the near-infrared light which penetrates LD5.
[0020] In this condition, bonding of LD5 and the base components 3 which were positioned was carried out with eutectic alloys, such as a golden tin alloy, and LD5 was fixed to the substrate 2. Next, it fixed to V groove 3c with adhesives etc., positioning an optical fiber 6 by V groove 3c of the base components 3, and the surface mount module 1 was manufactured. At this time, the optical fiber 6 performed positioning in the direction of V groove 3c by arranging RENZUDO fiber 6a to crossing slot 3a.
[0021] In addition, the thing of structure which attached RENZUDO fiber 8a of the diameter of said in the end, and attached ferrule 8b in the other end is sufficient as an optical fiber like the optical fiber 8 shown in drawing 5 . When an optical fiber 8 is used, relation with LD5 is positioned with a sufficient precision according to image recognition etc., observing the tip of RENZUDO fiber 8a under a microscope, and an optical fiber 8 is fixed to V groove 3c.
[0022] Here, although the base components 3 were created using the master components 10 in the above-mentioned example, it is also possible to create the base components 3 with high precision through two steps called the duplicate of a duplicate using the matrix beforehand created with silicon etc. with said precision replica method. A matrix is the same configuration as the base components 3, and can be created with high precision by the photolithography using silicon etc. Master components are created for what was created in the same configuration as this base component 3 with precision replica methods, such as electroforming and the sputtering method, as a matrix of master components. It is possible for one matrix to carry out sufficient management, and to create it with high precision, and for many pieces to create master components with high precision from this matrix by using this approach. By the sputtering method, non-electric conduction ingredients, such as silicon, are also usable, and can select and use an ingredient with high dimensional accuracy.
[0023] Moreover, the base components 3 have been cheaply manufactured in a high precision with electroforming. And since the base components 3 are constituted from the metal by synthetic resin and ceramic system adhesives containing filler metal whose Plastic solid 4 is a thermally conductive material and the surface mount module 1 is excellent in the heat dissipation nature of a substrate 2, it can enlarge the optical output of carried LD5.
[0024]
[Effect of the Invention] By the above explanation, since an OPTO semiconductor device, for example, the base components which have the helicopter-loading-site mark of semiconductor laser and the positioning section of an optical fiber, is created from master components with a precision replica method, a surface mount module can be cheaply manufactured in a high precision, and, moreover, the optical output of the carried semiconductor laser can be enlarged according to the surface mount module and its manufacture approach of this invention, so that clearly.
[0025] Since that by which the RENZUDO fiber with which it has the isotropic refractive index in which an optical fiber does not have a core at this time, and the end was processed on the convex surface was prepared in the edge is used, it is the distance between an optical fiber and an OPTO semiconductor device 100 The allowable error about a gap of the optical axis of the optical fiber in more than mum and the longitudinal direction which intersects perpendicularly with the optical axis of an OPTO semiconductor device can be set to 1 micrometers or more, positioning of a component part is easy and big effect is not produced in joint effectiveness.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to a surface mount module and its manufacture approach.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In the optic fiber communication system, the system which can transmit a lightwave signal is examined also from the subscriber (home) side as two-way communication. In order to attain such an optic fiber communication system, the surface mount module which combined the carrier and the light emitting device, and the optical fiber was required, and as it was the following, the carrier and the light emitting device, and the optical fiber were combined conventionally.

[0003] That is, when a laser diode (henceforth "LD") and an optical fiber were combined, the relative-position relation between the mark for carrying LD with a sufficient precision on a silicon substrate and this mark was set as submicron order, formed the V groove which positions an optical fiber, and had combined LD and an optical fiber on this substrate. Here, using a silicon substrate is based on the following reasons. A gap of the physical relationship a temperature expansion coefficient is the same as that of an optical fiber, and according to a temperature change does not produce [1st] a silicon substrate easily. The 2nd silicon substrate is being able to form the V groove which positions the mark and optical fiber for LD loading with high precision using lithography, anisotropic etching, etc. A silicon substrate is [3rd] because near-infrared light is made to penetrate and the helicopter loading site of LD or an optical fiber can be observed from a background.

[0004] Moreover, how to combine with LD using the RENZUDO fiber into which thermofusion of the edge was carried out and the convex surface was processed is also learned conventionally. However, when the above-mentioned RENZUDO fiber was used, spacing of LD and a RENZUDO fiber needed to be set to 5-10 micrometers, and the allowable error of LD in the longitudinal direction which intersects perpendicularly with the optical axis of a RENZUDO fiber needed to be set to 1 micrometer or less.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] By the above explanation, since an OPTO semiconductor device, for example, the base components which have the helicopter-loading-site mark of semiconductor laser and the positioning section of an optical fiber, is created from master components with a precision replica method, a surface mount module can be cheaply manufactured in a high precision, and, moreover, the optical output of the carried semiconductor laser can be enlarged according to the surface mount module and its manufacture approach of this invention, so that clearly.
[0025] Since that by which the RENZUDO fiber with which it has the isotropic refractive index in which an optical fiber does not have a core at this time, and the end was processed on the convex surface was prepared in the edge is used, it is the distance between an optical fiber and an OPTO semiconductor device 100 The allowable error about a gap of the optical axis of the optical fiber in more than mum and the longitudinal direction which intersects perpendicularly with the optical axis of an OPTO semiconductor device can be set to 1 micrometers or more, positioning of a component part is easy and big effect is not produced in joint effectiveness.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, the handling [equipment / expensive processing equipment is required and / a substrate] in a processing process carefully to process a silicon substrate with high precision with lithography. On the other hand, to process it using anisotropic etching, precision needs to improve alignment or it is necessary to control etching conditions for bearing of a silicon substrate to a precision to the mask for etching.

[0006] for this reason, the above — also in which processing approach, if processing conditions are bad, as a result of dispersion and the yield worsening [the process tolerance of said mark in the processed silicon substrate, or a V groove], there is a problem that a product (surface mount module) becomes expensive. In this case, although processing a silicon substrate mechanically is also considered, productivity is bad and there is a problem of becoming expensive in using it for a surface mount module for home use, as a result of processing cost's increasing.

[0007] On the other hand, LD generates heat inevitably in order to pass a big current by the unit area ratio. In this case, since thermal conductivity is not good compared with a metal, heat dissipation nature of a silicon substrate is bad. For this reason, in the surface mount module using a silicon substrate, since the optical output of LD is saturated with a low current value, there is also a problem that an optical output cannot be enlarged. Furthermore, by the surface mount module using the conventional RENZUDO fiber, when the material with a large coefficient of thermal expansion was used as a substrate, there was a possibility that LD and a RENZUDO fiber might be collided and damaged by the temperature change. And since the above-mentioned allowable error is 1 micrometer or less, become dispersion in joint effectiveness, and the yield of the surface mount module assembled falls, or a gap of said longitudinal direction produced when combining LD and a RENZUDO fiber becomes the cause which a manufacturing cost increases.
[0008] This invention was made in view of the above-mentioned point, and can be cheaply manufactured in a high precision, and it aims at offering the surface mount module which can moreover enlarge the optical output of the carried OPTO semiconductor device, and its manufacture approach.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose according to this invention, in the surface mount module manufactured by carrying an OPTO semiconductor device and an optical fiber on a substrate, it has the irregularity corresponding to the helicopter-loading-site mark of said OPTO semiconductor device, and the positioning section of said optical fiber for said substrate, and constituted from a Plastic solid united with the base components formed by the precision replica method, and said base component.
[0010] Preferably, thermally conductive materials, such as a filler metal close resin metallurgy group injection-molding object, are used as said Plastic solid. Moreover, preferably, said optical fiber has an isotropic refractive index without a core, and that by which the RENZUDO fiber with which the end was processed on the convex surface was prepared in the edge is used for it. Furthermore, in order to attain the above-mentioned purpose, after irregularity formed the imprint object with the precision replica method from the master components formed conversely and backed said imprint object with a thermally conductive material to the substrate which has the helicopter-loading-site mark of an OPTO semiconductor device, and the positioning section of an optical fiber according to the manufacture approach of the surface mount module of this invention, it considered as the configuration which positions an optical fiber by said positioning section, respectively, and carries an OPTO semiconductor device based on said helicopter-loading-site mark.
[0011] Here, the "precision replica method" used on these specifications means a means to imprint the irregularity of master components with the molecular level of submicron order, and to form an imprint object, for example, there are electroforming, the sputtering method, etc. If the base components formed by the precision replica method are used, the helicopter-loading-site mark of an OPTO semiconductor device and the positioning section of said optical fiber will be imprinted by the precision from master components, and the surface mount module carrying an OPTO semiconductor device and an optical fiber will be cheaply manufactured in a high precision. Furthermore, it consists of a thermally conductive material, and if the Plastic solid united with base components is used, compared with the conventional surface mount module using a bad silicon substrate, heat dissipation nature can improve and heat dissipation nature can enlarge the optical output of the carried OPTO semiconductor device, for example, semiconductor laser.
[0012] When that by which the RENZUDO fiber with which it has the isotropic refractive index in which an optical fiber does not have a core at this time, and the end was processed on the convex surface was prepared in the edge is used, it is the distance between an optical fiber and an OPTO semiconductor device 100 The big effect in joint effectiveness as 1 micrometers or more does not produce the allowable error about a gap of the optical axis of the optical fiber in more than mum and the longitudinal direction which intersects perpendicularly with the optical axis of an OPTO semiconductor device.
[0013]
[Embodiment of the Invention] Hereafter, one example of this invention is explained to a detail based on drawing 1 thru/or drawing 7 . LD5 and an optical fiber 6 align an optical axis to a substrate 2, and the surface mount module 1 is carried in it, as shown in drawing 1 and drawing 2 . The substrate 2 consists of base components 3 and Plastic solid 4. V groove 3c is formed in another side for mark 3b which is slightly low and shows the helicopter loading site of LD5 to one side while the base components 3 sandwich crossing slot 3a formed crosswise, respectively. Mold shaping is carried out with a thermally conductive material, for example, the synthetic resin containing filler metal, the ceramic system adhesives containing filler metal, or a metal injection Plastic solid (what is called a common name MIM), and Plastic solid 4 is united with the base components 3 as shown in drawing 3 (a) and drawing 3 (b).
[0014] In order to improve a laser oscillation property, two trenches 5a is formed in a component side, mark 5b (refer to drawing 4 , respectively) positions LD5 on the outside of each trench 5a with high precision to a barrier layer, and it is prepared in it. LD5 is carried in V groove 3c which sandwiched crossing slot 3a, and the location which counters, as shown in drawing 1 . In addition, in drawing 4 , in order to show details clearly, compared with the substrate 2 shown in right-hand side, left-hand side LD5 is expanded relatively, and is drawn.
[0015] An optical fiber 6 is positioned by V groove 3c, and is carried in the base components 3, RENZUDO fiber 6a of a large diameter is attached in an end, and ferrule 6b is attached in the other end. RENZUDO fiber 6a has an isotropic refractive index without a core, and the tip is processed on the convex surface. Ferrule 6b is a single alignment ferrule which connects an optical fiber 6 with other optical fibers.
[0016] The surface mount module 1 constituted as mentioned above is the following, and is made and manufactured. First, the master components 10 shown in drawing 6 were prepared that the base components 3 should be created. Irregularity is created with a precision sufficient in a reverse relation to the base components 3 which have crossing

slot 3a, mark 3b, and V groove 3c, and the master components 10 have ridge 10c corresponding to crevice 10b corresponding to protruding line 10a corresponding to crossing slot 3a, and mark 3b, and V groove 3c. Electric conduction ingredients, such as non-electric conduction ingredients, such as silicon, and nickel, Cu, can be used for the master components 10.

[0017] Next, when the master components 10 consist of a non-electric conduction ingredient, flash plating of nickel, the copper, etc. is carried out to a front face, and they are conductor-ized on it. the case where the master components 10 consist of an electric conduction ingredient — a surface conductor ——izing processing is unnecessary. Subsequently, as the master components 10 were used as cathode and shown in drawing 7 (a), the thick electroplating layers 11, such as nickel and copper, were formed in the front face of the master components 10 with electroforming. If many master components 10 are put in order at this time, many base components 3 can be created at once.

[0018] In this case, it is also considered that electrocasting takes several days. However, electroforming has the advantage that the cost which electrocasting takes is also cheap in a electrocasting facility list, in the shape of toothing of the master components 10 being reproducible with a sufficient precision to submicron order. Next, the electroplating layer 11 was removed from the master components 10, and as shown in drawing 7 (b), the base components 3 which have crossing slot 3a, mark 3b, and V groove 3c were obtained.

[0019] Subsequently, the obtained base components 3 were set to metal mold, Plastic solid 4 was fabricated by insertion mold using the thermally conductive material which consists of synthetic resin, ceramic system adhesives, etc. containing filler metal, and the substrate 2 was created. As shown in drawing 4 after an appropriate time, LD5 has been arranged among the marks 3b and 3b formed in the substrate 2, though it was inside-out. And near-infrared light was irradiated from the upper part of a substrate 2, and LD5 was positioned to the base components 3 in the precision of about 1 micrometer by approaches, such as image recognition, observing each mark 5b and corresponding mark 3b with a vidicon camera with a microscope by the near-infrared light which penetrates LD5.

[0020] In this condition, bonding of LD5 and the base components 3 which were positioned was carried out with eutectic alloys, such as a golden tin alloy, and LD5 was fixed to the substrate 2. Next, it fixed to V groove 3c with adhesives etc., positioning an optical fiber 6 by V groove 3c of the base components 3, and the surface mount module 1 was manufactured. At this time, the optical fiber 6 performed positioning in the direction of V groove 3c by arranging RENZUDO fiber 6a to crossing slot 3a.

[0021] In addition, the thing of structure which attached RENZUDO fiber 8a of the diameter of said in the end, and attached ferrule 8b in the other end is sufficient as an optical fiber like the optical fiber 8 shown in drawing 5 . When an optical fiber 8 is used, relation with LD5 is positioned with a sufficient precision according to image recognition etc., observing the tip of RENZUDO fiber 8a under a microscope, and an optical fiber 8 is fixed to V groove 3c.

[0022] Here, although the base components 3 were created using the master components 10 in the above-mentioned example, it is also possible to create the base components 3 with high precision through two steps called the duplicate of a duplicate using the matrix beforehand created with silicon etc. with said precision replica method. A matrix is the same configuration as the base components 3, and can be created with high precision by the photolithography using silicon etc. Master components are created for what was created in the same configuration as this base component 3 with precision replica methods, such as electroforming and the sputtering method, as a matrix of master components. It is possible for one matrix to carry out sufficient management, and to create it with high precision, and for many pieces to create master components with high precision from this matrix by using this approach. By the sputtering method, non-electric conduction ingredients, such as silicon, are also usable, and can select and use an ingredient with high dimensional accuracy.

[0023] Moreover, the base components 3 have been cheaply manufactured in a high precision with electroforming. And since the base components 3 are constituted from the metal by synthetic resin and ceramic system adhesives containing filler metal whose Plastic solid 4 is a thermally conductive material and the surface mount module 1 is excellent in the heat dissipation nature of a substrate 2, it can enlarge the optical output of carried LD5.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view showing the surface mount module of this invention.
[Drawing 2] It is the sectional view of the module of drawing 1 .
[Drawing 3] The sectional view of the substrate with which drawing 3 (a) constitutes the module of drawing 1 , and drawing 3 (b) are right side views.
[Drawing 4] In the surface mount module of drawing 1 , it is the perspective view showing the condition of fixing LD to a substrate.
[Drawing 5] It is the front view showing the modification of the optical fiber used for the surface mount module of drawing 1 .
[Drawing 6] It is the perspective view of the master components used for manufacture of the surface mount module of drawing 1 .
[Drawing 7] It is process drawing showing manufacture of the base components using the master components of drawing 6 .
[Description of Notations]
1 Surface Mount Module
2 Substrate
3 Base Components
3a Crossing slot
3b Mark
3c V groove
4 Plastic Solid
5 LD
5a Trench
5b Mark
6 Optical Fiber
6a RENZUDO fiber
6b Ferrule
8 Optical Fiber
8a RENZUDO fiber
8b Ferrule
10 Master Components
10a Protruding line
10b Crevice
10c Ridge
11 Electroplating Layer

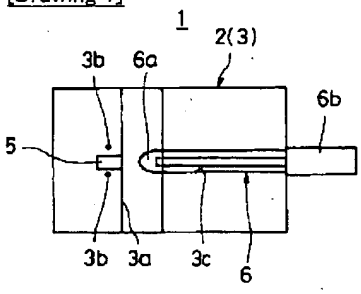
[Translation done.]

* NOTICES *

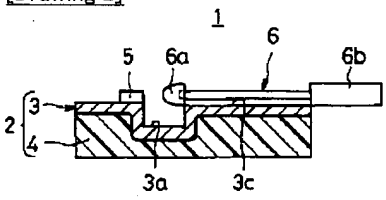
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

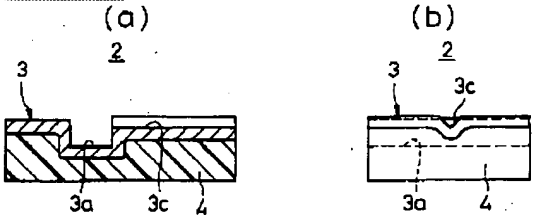
[Drawing 1]



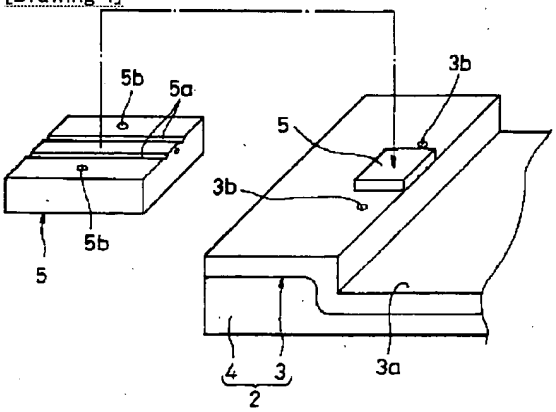
[Drawing 2]



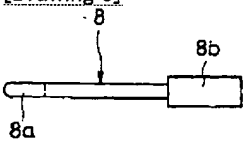
[Drawing 3]



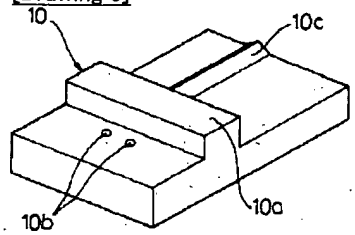
[Drawing 4]



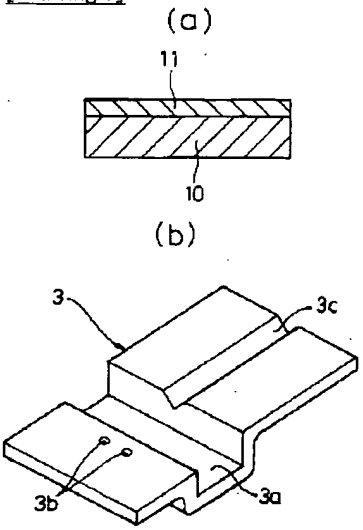
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]

GP-448-3 (NP-1479) (Y)

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（A）**　(11)特許出願公開番号

特開平9－90173

(43)公開日　平成９年(1997)４月４日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｇ０２Ｂ　6/42			Ｇ０２Ｂ　6/42	

審査請求　未請求　請求項の数４　ＯＬ　（全 5 頁）

(21)出願番号　特願平7－249643

(22)出願日　平成７年(1995)９月27日

(71)出願人　000005290
古河電気工業株式会社
東京都千代田区丸の内２丁目６番１号

(72)発明者　大石　勇
東京都千代田区丸の内２丁目６番１号　古河電気工業株式会社内

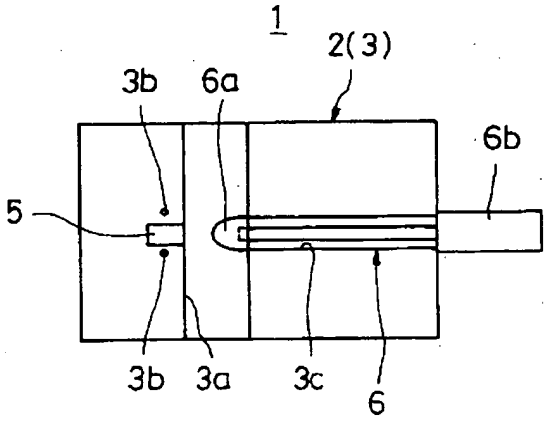
(74)代理人　弁理士　長門　侃二

(54)【発明の名称】　表面実装モジュールとその製造方法

(57)【要約】

【課題】　高い精度で安価に製造でき、しかも、搭載した光半導体素子の光出力を大きくすることが可能な表面実装モジュールとその製造方法を提供する。

【解決手段】　基板２上に光半導体素子５と光ファイバ６とを搭載して製造される表面実装モジュールとその製造方法。基板２が、光半導体素子５の搭載位置マーク３ｂと光ファイバの位置決め部３ｃとを有し、精密転写法によって形成されるベース部品３と、ベース部品と一体化される成形体４とで構成される。



【特許請求の範囲】
【請求項１】　基板上に光半導体素子と光ファイバとを搭載して製造される表面実装モジュールにおいて、前記基板が、前記光半導体素子の搭載位置マークと前記光ファイバの位置決め部とを有し、精密転写法によって形成されるベース部品と、前記ベース部品と一体化される成形体とで構成されることを特徴とする表面実装モジュール。
【請求項２】　前記基板の精密転写法によって形成されるベース部品と一体化される成形体として、金属フィラー入樹脂や金属射出成形体等の熱伝導性素材からなる、請求項１の表面実装モジュール。
【請求項３】　前記光ファイバは、コアのない等方性の屈折率を有し、一端が凸曲面に加工されたレンズドファイバが端部に設けられている、請求項１又は２の表面実装モジュール。
【請求項４】　光半導体素子の搭載位置マークと光ファイバの位置決め部とを有する基板に対して凹凸が逆に形成されたマスタ部品から精密転写法により転写体を形成し、
前記転写体を熱伝導性素材で裏打ちした後、
前記搭載位置マークに基づいて光半導体素子を、前記位置決め部により光ファイバを、それぞれ位置決めして搭載することを特徴とする表面実装モジュールの製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、表面実装モジュールとその製造方法に関する。
【０００２】
【従来の技術】光ファイバ通信システムにおいては、双方向通信として加入者（家庭）側からも光信号を伝送可能なシステムが検討されている。このような光ファイバ通信システムを達成するためには、受・発光素子と光ファイバとを結合した表面実装モジュールが必要であり、従来は、例えば、以下のようにして受・発光素子と光ファイバとを結合していた。
【０００３】即ち、レーザダイオード（以下、「ＬＤ」という）と光ファイバとを結合する場合には、シリコン基板上にＬＤを精度良く搭載するためのマークと、このマークとの相対位置関係がサブミクロンオーダーに設定され、光ファイバを位置決めするＶ溝とを形成し、この基板上でＬＤと光ファイバとを結合していた。ここで、シリコン基板を使用するのは、以下の理由による。第１に、シリコン基板は、温度膨張係数が光ファイバと同一で温度変化による位置関係のずれが生じ難いこと。第２に、シリコン基板は、ＬＤ搭載用のマークや光ファイバを位置決めするＶ溝をリソグラフィや異方性エッチング等を用いて高精度に形成できること。第３に、シリコン基板は、近赤外光を透過させて裏側からＬＤや光ファイバの搭載位置が観察できることによる。
【０００４】また、従来、端部を熱溶融して凸曲面に加工したレンズドファイバを用いてＬＤと結合する方法も知られている。しかし、上記レンズドファイバを用いた場合、ＬＤとレンズドファイバとの間隔を５～１０μｍにセットし、レンズドファイバの光軸と直交する横方向におけるＬＤの許容誤差を１μｍ以下にする必要があった。
【０００５】
【発明が解決しようとする課題】ところで、リソグラフィによってシリコン基板を高精度に加工する場合は、高価な加工装置が必要で、加工工程において基板の取り扱いを慎重に行う必要がある。一方、異方性エッチングを使用して加工する場合には、シリコン基板の方位をエッチング用マスクに対して精度良く位置合わせしたり、エッチング条件を精密に制御する必要がある。
【０００６】このため、上記いずれの加工方法においても、加工条件が悪いと、加工されたシリコン基板における前記マークやＶ溝の加工精度がばらつき、歩留まりが悪くなる結果、製品（表面実装モジュール）が高価になるという問題がある。この場合、シリコン基板を機械的に加工することも考えられるが、生産性が悪く、加工コストが嵩む結果、家庭用の表面実装モジュールに使用するには高価になるという問題がある。
【０００７】一方、ＬＤは、単位面積比で大きな電流を流すため必然的に発熱する。この場合、シリコン基板は、金属に比べて熱伝導性が良くないため、放熱性が悪い。このため、シリコン基板を用いた表面実装モジュールにおいては、低い電流値でＬＤの光出力が飽和することから、光出力を大きくできないという問題もある。更に、従来のレンズドファイバを用いた表面実装モジュールでは、熱膨張率の大きい素材を基板として使用すると、温度変化によってＬＤとレンズドファイバとが衝突して損傷するおそれがあった。しかも、上記許容誤差が１μｍ以下であることから、ＬＤとレンズドファイバとを結合するときに生ずる前記横方向のずれは、結合効率のばらつきとなり、組み立てられる表面実装モジュールの歩留まりが低下したり、製造コストが増加する原因となる。
【０００８】本発明は上記の点に鑑みてなされたもので、高い精度で安価に製造でき、しかも、搭載した光半導体素子の光出力を大きくすることが可能な表面実装モジュールとその製造方法を提供することを目的とする。
【０００９】
【課題を解決するための手段】本発明によれば上記目的を達成するため、基板上に光半導体素子と光ファイバとを搭載して製造される表面実装モジュールにおいて、前記基板を、前記光半導体素子の搭載位置マークと前記光ファイバの位置決め部とに対応する凹凸を有し、精密転写法によって形成されるベース部品と、前記ベース部品

と一体化される成形体とで構成したのである。

【００１０】好ましくは、前記成形体として金属フィラー入樹脂や金属射出成形体等の熱伝導性素材を用いる。また好ましくは、前記光ファイバは、コアのない等方性の屈折率を有し、一端が凸曲面に加工されたレンズドファイバが端部に設けられたものを用いる。更に、上記目的を達成するため本発明の表面実装モジュールの製造方法によれば、光半導体素子の搭載位置マークと光ファイバの位置決め部とを有する基板に対して凹凸が逆に形成されたマスタ部品から精密転写法により転写体を形成し、前記転写体を熱伝導性素材で裏打ちした後、前記搭載位置マークに基づいて光半導体素子を、前記位置決め部により光ファイバを、それぞれ位置決めして搭載する構成としたのである。

【００１１】ここで、本明細書で使用する「精密転写法」とは、マスタ部品の凹凸をサブミクロンオーダーの分子レベルで転写して転写体を形成する手段をいい、例えば、電鋳法やスパッタリング法等がある。精密転写法によって形成されるベース部品を使用すると、光半導体素子の搭載位置マークと前記光ファイバの位置決め部とがマスタ部品から精密に転写され、光半導体素子と光ファイバとを搭載した表面実装モジュールが高い精度で安価に製造される。更に、熱伝導性素材からなり、ベース部品と一体化される成形体を使用すれば、放熱性が悪いシリコン基板を用いた従来の表面実装モジュールに比べ放熱性が向上し、搭載した光半導体素子、例えば半導体レーザの光出力を大きくすることができる。

【００１２】このとき、光ファイバは、コアのない等方性の屈折率を有し、一端が凸曲面に加工されたレンズドファイバが端部に設けられたものを用いると、光ファイバと光半導体素子との間の距離を100 μｍ以上、また、光半導体素子の光軸と直交する横方向における光ファイバの光軸のずれに関する許容誤差を１μｍ以上としても結合効率に大きな影響は生じない。

【００１３】

【発明の実施の形態】以下、本発明の一実施例を図１乃至図７に基づいて詳細に説明する。表面実装モジュール１は、図１及び図２に示すように、基板２にＬＤ５と光ファイバ６とが光軸を調心して搭載されている。基板２は、ベース部品３と成形体４とで構成されている。ベース部品３は、幅方向に形成された横断溝３ａを挟む一方が僅かに低く、一方にＬＤ５の搭載位置を示すマーク３ｂが、他方にＶ溝３ｃが、それぞれ形成されている。成形体４は、熱伝導性素材、例えば、金属フィラー入りの合成樹脂、金属フィラー入りのセラミック系接着剤、あるいは金属射出成形体（通称ＭＩＭと呼ばれるもの）等でモールド成形され、図３（ａ），図３（ｂ）に示すように、ベース部品３と一体化される。

【００１４】ＬＤ５は、レーザ発振特性を改良するため２本のトレンチ５ａが実装面に形成され、各トレンチ５ａの外側にマーク５ｂ（それぞれ図４参照）が活性層に対して高精度に位置決めして設けられている。ＬＤ５は、図１に示したように、横断溝３ａを挟んだＶ溝３ｃと対向する位置に搭載される。尚、図４において、左側のＬＤ５は、細部を明確に示すため右側に示した基板２に比べて相対的に拡大して描いてある。

【００１５】光ファイバ６は、Ｖ溝３ｃで位置決めしてベース部品３に搭載され、一端に太径のレンズドファイバ６ａが、他端にフェルール６ｂが取り付けられている。レンズドファイバ６ａは、コアのない等方性の屈折率を有し、先端が凸曲面に加工されている。フェルール６ｂは、光ファイバ６を他の光ファイバと接続する単心フェルールである。

【００１６】以上のように構成される表面実装モジュール１は、以下のようにして製造される。先ず、ベース部品３を作成すべく、図６に示すマスタ部品１０を用意した。マスタ部品１０は、横断溝３ａ，マーク３ｂ及びＶ溝３ｃを有するベース部品３に対して凹凸が逆の関係に精度良く作成され、横断溝３ａに対応する凸条１０ａ、マーク３ｂに対応する凹部１０ｂ及びＶ溝３ｃに対応するリッジ１０ｃを有している。マスタ部品１０は、シリコン等の非電気伝導材料や、Ｎｉ，Ｃｕ等の電気伝導材料を使用することができる。

【００１７】次に、マスタ部品１０が非電気伝導材料からなる場合には、ニッケル、銅等を表面にフラッシュメッキして導体化しておく。マスタ部品１０が電気伝導材料からなる場合には、表面の導体化処理は不要である。次いで、マスタ部品１０を陰極とし、図７（ａ）に示すように、電鋳法によりマスタ部品１０の表面にニッケル、銅等の厚い電気メッキ層１１を形成した。このとき、マスタ部品１０を多数並べておけば、ベース部品３を一度に多数作成することができる。

【００１８】この場合、電鋳に数日間を要することも考えられる。しかし、電鋳法は、マスタ部品１０の凹凸形状をサブミクロンオーダーで精度よく再現できるうえ、電鋳設備並びに電鋳に要するコストも安価であるという利点がある。次に、マスタ部品１０から電気メッキ層１１を剥がし取り、図７（ｂ）に示すように、横断溝３ａ，マーク３ｂ及びＶ溝３ｃを有するベース部品３を得た。

【００１９】次いで、得られたベース部品３を金型にセットし、金属フィラー入りの合成樹脂やセラミック系接着剤等からなる熱伝導性素材を用いて成形体４をインサートモールドにより成形し、基板２を作成した。しかる後、図４に示すように、ＬＤ５を裏返しながら基板２に形成されたマーク３ｂ，３ｂの間に配置した。そして、基板２の上方から近赤外光を照射し、ＬＤ５を透過する近赤外光によって、各マーク５ｂと対応するマーク３ｂとを顕微鏡付ビジコンカメラで観察しながら画像認識等の方法により１μｍ程度の精度でＬＤ５をベース部品３

に対して位置決めした。

【００２０】この状態で、位置決めしたＬＤ５とベース部品３とを金スズ合金等の共晶合金でボンディングし、ＬＤ５を基板２に固定した。次に、光ファイバ６をベース部品３のＶ溝３ｃで位置決めしながら接着剤等でＶ溝３ｃに固定し、表面実装モジュール１を製造した。このとき、光ファイバ６は、レンズドファイバ６ａを横断溝３ａに配置することでＶ溝３ｃ方向における位置決めを行った。

【００２１】尚、光ファイバは、図５に示す光ファイバ８のように、一端に同径のレンズドファイバ８ａを、他端にフェルール８ｂを取り付けた構造のものでもよい。光ファイバ８を使用したときには、レンズドファイバ８ａの先端を顕微鏡で観察しながらＬＤ５との関係を画像認識等によって精度良く位置決めし、光ファイバ８をＶ溝３ｃに固定する。

【００２２】ここで、上記実施例ではマスタ部品１０を用いてベース部品３を作成したが、予めシリコン等で作成した母型を用い、前記精密転写法によって複製の複製という２段階を経てベース部品３を高精度に作成することも可能である。母型は、ベース部品３と同じ形状で、シリコン等を用いてフォトリソグラフィで高精度に作成することができる。このベース部品３と同じ形状で作成したものを、マスター部品の母型として電鋳法、スパッタリング法等の精密転写法でマスター部品を作成する。この方法を用いることで、母型は一つを十分な管理をして高精度に作成し、マスター部品をこの母型から何個も高精度に作成することが可能である。スパッタリング法ではシリコン等の非電気伝導材料も使用可能で、寸法精度の高い材料を選定して使用できる。

【００２３】また、ベース部品３は、電鋳法によって高い精度で安価に製造できた。しかも、表面実装モジュール１は、ベース部品３が金属で成形体４が熱伝導性素材である金属フィラー入りの合成樹脂やセラミック系接着剤で構成されているので、基板２の放熱性に優れているため、搭載したＬＤ５の光出力を大きくすることができる。

【００２４】

【発明の効果】以上の説明で明らかなように、本発明の表面実装モジュールとその製造方法によれば、光半導体素子、例えば、半導体レーザの搭載位置マークと光ファイバの位置決め部とを有するベース部品を精密転写法によってマスタ部品から作成するので、表面実装モジュールを高い精度で安価に製造でき、しかも、搭載した半導体レーザの光出力を大きくすることができる。

【００２５】このとき、光ファイバは、コアのない等方性の屈折率を有し、一端が凸曲面に加工されたレンズドファイバが端部に設けられたものを用いるので、光ファイバと光半導体素子との間の距離を100 μｍ以上、また、光半導体素子の光軸と直交する横方向における光ファイバの光軸のずれに関する許容誤差を１μｍ以上とすることができ、構成部品の位置決めが容易で、結合効率に大きな影響は生じない。

【図面の簡単な説明】

【図１】本発明の表面実装モジュールを示す平面図である。

【図２】図１のモジュールの断面図である。

【図３】図３（ａ）は図１のモジュールを構成する基板の断面図、図３（ｂ）は右側面図である。

【図４】図１の表面実装モジュールにおいて、ＬＤを基板に固定する状態を示す斜視図である。

【図５】図１の表面実装モジュールに用いる光ファイバの変形例を示す正面図である。

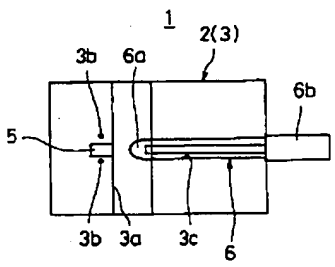
【図６】図１の表面実装モジュールの製造に使用するマスタ部品の斜視図である。

【図７】図６のマスタ部品を用いたベース部品の製造を示す工程図である。

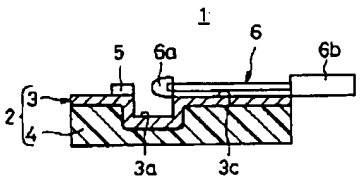
【符号の説明】

１	表面実装モジュール
２	基板
３	ベース部品
３ａ	横断溝
３ｂ	マーク
３ｃ	Ｖ溝
４	成形体
５	ＬＤ
５ａ	トレンチ
５ｂ	マーク
６	光ファイバ
６ａ	レンズドファイバ
６ｂ	フェルール
８	光ファイバ
８ａ	レンズドファイバ
８ｂ	フェルール
１０	マスタ部品
１０ａ	凸条
１０ｂ	凹部
１０ｃ	リッジ
１１	電気メッキ層

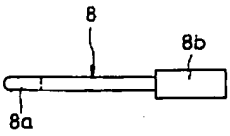
【図１】



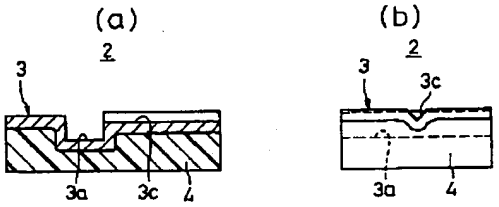
【図２】



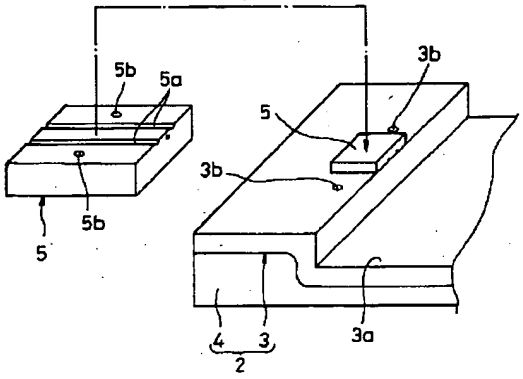
【図５】



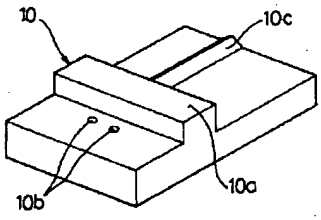
【図３】



【図４】



【図６】



【図７】